University of Bahrain
College of Information technology
Department of Computer Engineering

Test (1)

Student Name	
I.D. No.	
Section	

Course Title: Digital Logic
Course number: ITCE 202
Semester: 2
Academic Year: 2008/2009
Duration : 1 hour 15 minutes
Date: 27th April 2009

Read the following before you start:
1. Write your name, ID and section number
2. Answer all questions.
3. Write your answers on the attached sheets only.

Question	Mark	Mark attained
1	30	
2	20	
3	20	
4	30	
Total	100	

Question [1]: [30 mark]

a. Convert the following numbers showing all steps. [4 marks each]

$(D38.5)_{16} = (\quad)_4$

$(0011\ 0010)_{BCD} = (\quad)_{excess\text{-}3}$

$(6)_{10} = (\quad)_{7\text{-}4\text{-}4\text{-}1}$

$(100010010100)_{2's\ complement} = (\quad)_{1's\ complement}$

$(-15)_{10} = (\quad)_{2's\ complement}$

$(+15)_{10} = (\quad)_{1's\ complement}$

b. Add the following 2's complement numbers and indicate if over flow occur. [4 marks]

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  1 1 1 1 0 1 1
+1 0 0 0 1 1 1
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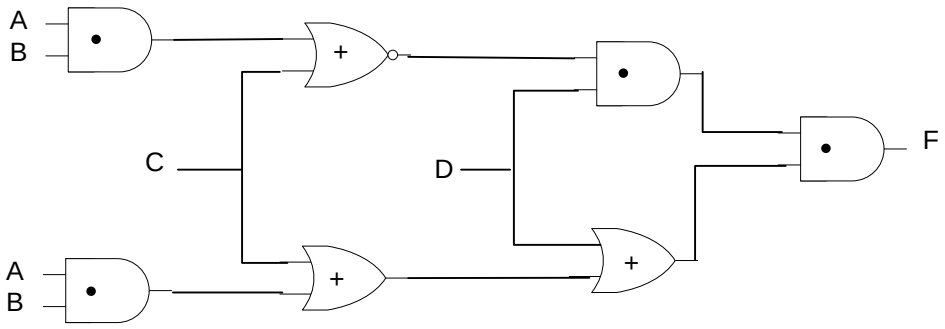
c. What is the largest number can be represented in 9-bit word length? [2 marks]

Question [2] : [20 mark]

a. Find and simplify the Boolean expression of the following logic circuit. [12 mark]

b. How many level the circuit consist of ?



c. Apply DeMorgan's Law directly on the following expression to find Z', do not simplify. [8 marks]

$$Z = \Big(\big(A \oplus B\big)' + \big(CD + F\big)A' \Big)D + \big(A \oplus B'\big)$$

Question [3]: [20 mark]

a. Design a minimum three-level circuit to realize the following Boolean function using all NOR gate circuit. Draw the circuit. Do not use inverter at output.

$$f(A,B,C,D) = \overline{A}B + A\overline{D} + A\overline{B}\overline{C}$$

b. Repeat part (a) using 4-level all NOR circuit.

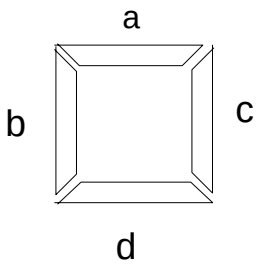
c. Design a minimum logic circuit to realize the following Boolean function using all NAND gate circuit.(maximum of 3-input NAND gates)

$$f(A,B,C,D) = \Pi\, M(3,8,10,15) \bullet \Pi\, D(2,5,12)$$

Question [4]: [30 mark]

You are required to design a circuit that takes its input from a decimal keyboard, such as the one on your mobile phone and produces output directions on a 4-segment display, such as the one shown below. The keyboard generates a Binary Coded Decimal (BCD) number. Pressing the following keys produces the shown outputs:

Pressing number 2 key would produce an Up indication, by lighting the segments b, c and d.
Pressing number 8 key would produce a down indication, by lighting the segments a, b and c.
Pressing number 4 key would produce a left indication, by lighting the segments a, c and d.



Pressing number 6 key would produce a right indication, by lighting the segments a, b and d.

Pressing number 1 key would produce a LU indication, by lighting the segments a and b.

Pressing number 3 key would produce a RU indication, by lighting the segments a and c.

Pressing number 7 key would produce a LD indication, by lighting the segments b and d.

Pressing number 9 key would produce a RD indication, by lighting the segments c and d.

Assume that only the above mentioned keys work and all other keys on the keyboard are disabled.

For the above problem do the following;

a. Construct the truth table of the system.

b. Find the Minterm expansion of segment c in decimal notation.

c. Find the Maxterm expansion of segment d' in decimal notation.

d. Draw a minimum logic circuit for segment a using NAND gates only.

e. Find the minimum sum of products for segment b.

f. Show how you can make the circuit for segment d using an XOR gate in your design.